The Economics of Chemical Fallow

FarmFacts

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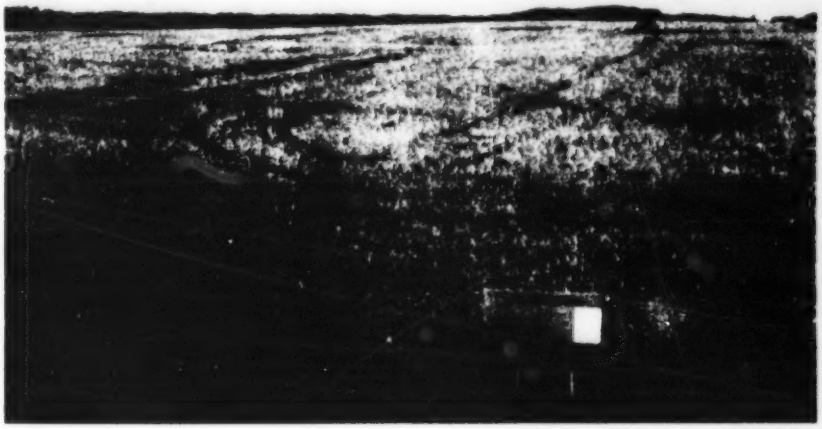
Soil degradation is a serious problem, and unfortunately, the traditional practice of tillage summerfallow has been shown to be one of the major causes of soil degradation on the prairies (Rennie, 1986). In response to the increased concern about soil erosion by those concerned with the long-term viability of agriculture, soil scientists have searched diligently for alternative farm practices which are compatible with the arid conditions of prairie agriculture, but are less soil eroding. One alternative is the recently endorsed practice of chemical fallow.



Chemical fallowing methods use herbicides to control weeds, rather then tillage used in conventional fallow systems. However, in the short term, from the individual farmer's point of view, this practice is expensive when compared to conventional tillage because of the relatively high costs of herbicides. Nonetheless, chemical fallow has an important advantage in that it maintains high levels of crop residue which reduces erosion by binding the soil together, thus protecting it from the natural elements. Therefore, chem-fallow may be preferred in the long-run because it slows down the process of erosion. However, the long term benefit may have associated with it some short term costs.

Therefore, the purpose of this paper is to examine the economic decision to chem-fallow on a typical farm in the brown soil zone of Saskatchewan. Where available, results of research at the University of Saskatchewan is used to calculate the benefits and costs of chem-fallow.

Examining the economics of the chemical fallow decision is not a trivial task. Many factors are important in determining whether chemical fallow is appropriate in a particular situation. For instance, cost of control, crop value, erodibility of the soil, length of planning horizon, weed densities and weed species are all important factors in the decision. In order to incorporate the implications of each of the above factors, we use a simple cost benefit analysis which evaluates the tradeoffs of chemical and conventional tillage summerfallow.

Economic costs

The economic cost of chem-fallow is the incremental increase in cost incurred when compared to the next best alternative available to the farmer. Therefore, it is the difference in the cost of chemical fallow relative to conventional tillage fallow. Table 1 illustrates the cost of chemical and tillage fallow based on a number of scenarios with regards to the weed control of chemical fallow. In the examples illustrated in this paper, it is assumed that chemical fallow reduces the number of field passes by 50% when compared with conventional tillage summerfallow. Obviously, the cost figures are quite sensitive to this assumption. If more operations are required, chem-fallow becomes less profitable relative to regular tillage fallow because the application costs of chem-fallow are greater, particularly if grassy weed control is a problem.

Equipment cost figures reported represent the variable costs associated with operating a cultivator (tillage fallow) and sprayer (chem-fallow), respectively (Schoney, Thorson and Weisensel, 1988). Excluding the fixed costs seems reasonable since the majority of farms have both sprayers and cultivators as part of their equipment complement.

We emphasize that the results presented in Table 1 are for the purposes of illustration only. They show the relative costs for a number of hypothetical farm operations (representative farms). The number of operations necessary to control

weed growth with chem-fallow or tillage fallow is sensitive to each individual's farm operation. Therefore, a farmer should use his own expectations regarding the number of applications and costs associated with chem-fallow versus tillage fallow for his farm operation.

Table 1: Relative Costs of Chemical and Tillage Summerfallow [a]

($/Acre)

Conventional Tillage Follow

Application	Chemical Cost	Equipment Cost	Total Cost
1	0.00	1.78	1.78
2	0.00	1.78	1.78
3	0.00	1.78	1.78
4	0.00	1.78	1.78
			7.12

Chemical Fallow (Broadleaf Control Only)

Application	Chemical Cost	Equipment Cost	Total Cost
1	3.03	0.83	3.86
2	2.14	0.83	2.97
			6.83

Chemical Fallow (Broadleaf and Grasses[b])

Application	Chemical Cost	Equipment Cost	Total Cost
1	8.98	0.83	9.81
2	2.14	0.83	2.97
			12.88

Chemical Fallow (Broadleaf and Grasses[c])

Application	Chemical Cost	Equipment Cost	Total Cost
1	8.98	0.83	9.81
2	8.98	0.83	9.81
			19.62

[a] The budgets above assume that 2,4-D is used in the fall prior to the summerfallow year to control winter annuals. The cost of this operation is not included in the budgets.
[b] The first application controls both grasses and broadleaf weeds while the second controls only broadleaf weed problems.
[c] In this scenario two applications of grassy weed herbicide are required in addition to broadleaf herbicide.

Other relevant factors

As part of the Innovative acres program, chemical and regular summerfallow comparisons were conducted over the period of 1982 to 1986. Overall sixteen comparisons were conducted of which 12 were located in the brown and dark brown soil zones. The comparisons concentrated on four major factors (Innovative Acres 1986 Report, 1987):

(1) Cost,
(2) Succeeding crop yields,
(3) Soil moisture, and
(4) Soil NO_3-N content.

The results showed that the average annual cost of chemical fallow is roughly three times that of regular fallow ($26.38/acre compared to $8.41/acre). This contrasts sharply with the results presented in Table 1 but can be explained by the reductions in herbicide prices which have occurred since the completion of the above research. Soil moisture conserved and succeeding crop yields for spring seeded crops were not significantly different for the two types of summerfallow practices. However, available soil nitrate contents after chemical fallow tended to be significantly lower than after regular tillage fallow. The average difference based on the Innovative Acres data is 12.5 lbs/acre. Therefore, increased nitrogen cost may be an important factor in the economics of the chem-fallow decision for fields which do not mineralize a surplus amount of nitrate nitrogen over the fallow period. Again, whether this is a factor, is dependent on a particular producer's situation. Based on current nitrogen fertilizer costs, 12.5 lbs/acre of nitrogen is worth more than $3.00. Finally, another factor to keep in mind is that the application of this nitrogen may require an additional operation during the subsequent crop year, which normally would not occur in the situation of regular tillage summerfallow. This should also be incorporated in the economic decision.

Benefits of chemical fallow

The major benefit of chem-fallow when compared to conventional tillage summerfallow is the reduction in soil erosion. Researchers found considerable visible evidence regarding the reductions in soil erosion due to chem-fallow (Innovative Acres 1986 Report). However, they were unable to provide any monetary value regarding the differences in soil losses between conventional tillage fallow and chemical fallow. This is not surprising, since this is an extremely difficult procedure which depends on a whole host of factors which include: (1) the price of wheat, (2) the length of the producers decision horizon, (3) the quality and depth of the soil, (4) the long run crop rotation, and (5) the erodibility of the soil in question.

The impact upon land productivity of erosion which occurs today has long term implications for a farm operation. Any amount of soil which erodes from a particular piece of land affects the productivity of that land for as long as it is farmed. Yield loss due to reduced soil productivity is gone forever. Therefore, the long-term loss in productivity associated with the erosion which occurs in a single year accrues to that year. For instance, suppose that erosion in a particular summerfallow year was extensive. As a result, yields the following year declined by 1 bushel/acre (and suppose that if you had used chemfallow none of the erosion would have occurred). Furthermore, assume that this loss in production is permanent. Therefore, the net

present value of this loss production over the time period under consideration, should be treated as a cost in the current year, since it is a result of the actions (regular summerfallow) of the current year. To complete the example, the economic cost of the 1 bushel/acre loss in productivity based on (1) a 25 year planning horizon discounted at 5 percent, (2) a 50/50 wheat-fallow rotation, and (3) a farmgate wheat price of $4.00/bushel is $28.20/acre in the current year.[1] To the extent to which land markets incorporate the productive value of a soil, the loss in productivity of 1 bushel/acre represents a $28.20/acre decline in the value of land. Therefore, even when the loss in productivity due to soil erosion does not appear large, the economic cost associated with the loss productivity can be substantial. It is up to the individual producer to determine how erosion may impact upon his land since the figure is extremely sensitive to each particular situation. Obviously, soils which are highly erodible are at substantially more risk, as are soils which are thin and of lower quality.

[1] *This is based on the financial formula to calculate the net present value of an annuity. The formula is:*

$$\frac{PV = v\ 1 - (1 + i)\text{-}n}{i}$$

where, V is the annual dollar value of productivity loss associated with the practice of regular tillage summerfallow as opposed to chem-fallow, n is the length of the decision horizon of the producer in years (i.e., how long he/she plans on farming the tract of land in the future), and i is the real rate of discount (agricultural lending rate less the rate of inflation).

What is the sacrifice to conserve soil

It is beyond the scope of current research knowledge to provide accurate estimates of the cost of soil erosion on more than a very general level. Therefore, the objective of this section is to illustrate the tradeoffs between practicing chem-fallow and tillage fallow for the three scenarios illustrated in Table 1. The results of this analysis are presented in Table 2.

Table 2: Evaluation of the Economical Decision to Chem-Fallow

Chem-Fallow Scenario	Variable Cost	Tillage Fallow Cost	Net Difference in Cost
Broadleaf only	6.83	7.12	(0.29)
Grassy and Broadleaf[a]	12.88	7.12	5.76
Grassy and Broadleaf[b]	19.62	7.12	12.50

[a] Includes only one application of herbicide to control grasses.
[b] Includes two applications of herbicide to control grasses.

Based on our example, if broadleaf weed control is the only concern during the summerfallow year, then chem-fallow is less costly than regular fallow. This is not surprising since many farmers find it cheaper to spray for weed control when compared to cultivation, because the difference in fuel and labour costs associated with the two operations. Therefore, there is no sacrifice in current profitability to practice soil conservation when the weed spectrum is limited to broadleaf varieties.

However, when grassy weed control is a problem during the summerfallow year, chem-fallow becomes substantially more costly then regular fallow. The difference can be attributed to the high cost of grass control herbicides. Even when only one application of grass controlling herbicide is necessary, chemfallow is $5.76/acre more expensive than regular tillage summerfallow. Consequently, based on this scenario, the representative farmer would be sacrificing $5.76/acre in short term profitability to conserve the soil.

If two applications of grass controlling herbicides are believed to be necessary, the cost of chem-fallow becomes even more prohibitive. In this case, the difference in cost associated with the two alternatives is $12.50/acre. This is the sacrifice associated with conserving the soil by practicing chemfallow.

Summary and conclusions

Overall, for most typical farm operations, chem-fallow is a more costly practice than regular tillage summerfallow when one examines short run profit margins. However, in many situations, what a producer sacrifices in current returns to practice chem-fallow may yield long-term benefits. Valuation of the long-term benefits of reduced soil erosion is difficult, but even small losses in productivity have significant economic consequences, since losses in productivity due to erosion are permanent. Research indicates that the longrun benefits chem-fallow are greatest for shallow and highly erodible soils. The ultimate decision of whether to employ the practice depends critically on how much in current returns a producer is willing to sacrifice to maintain soil productivity and how well he understands the future implications of his current actions.

As a final comment, the results of other research associated with the use of chem-fallow should be noted. The analysis in this paper is based on a comparison of chemical and tillage summerfallow as a moisture conserving practice for spring seeded crops. In contrast, research undertaken at the Swift Current research Station suggests that chemical fallow may be more beneficial in two year rotations of winter wheat and summerfallow. In addition to its soil conserving properties, chem-fallow has a second advantage over regular tillage fallow with winter wheat since chem-fallow provides the necessary stubble snow catch to reduce losses associated with winter kill. In fact, a recent study indicated that a winter wheat chem-fallow rotation is just as profitable over a five year period as a spring wheat regular tillage fallow rotation in the Swift Current region (McConkey, Zentner and Nicholaichuck, 1989). In fact, their results also indicate that there is less risk associated with the winter wheat rotation.

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